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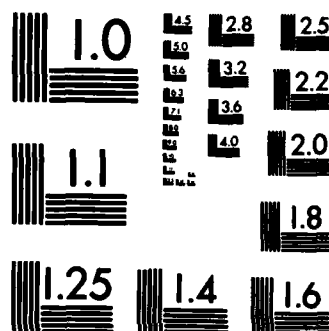
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Contract N00014-84-C-2137

Final Report

For the period 24 April 1984 through 23 April 1985

Principal Investigator

Michael Shao

June 1985

Prepared for  
Naval Research Laboratory  
Washington, DC 20375

Smithsonian Institution  
Astrophysical Observatory  
Cambridge, MA 02138

The Smithsonian Astrophysical Observatory  
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<p>The Mark III Astrometric Interferometer is an instrument designed to improve on our ability to measure angular positions of stars by more than an order of magnitude. The instrument makes extensive use of active optics, digital signal processing and control, and laser metrology. This report describes the efforts of the first year of a four-year program to build the Mark III interferometer, as well as obstacles to technical progress due to Navy administrative procedures.</p> <p><i>Keywords include:</i></p>					
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This is the final report for Contract N00014-84-C-2137. Originally this was to be a four-year program for which this report would be the report of the first year's effort. During the first year, the principal responsibility of SAO under this contract was to coordinate the technical efforts of the four institutions on the Mark III stellar interferometer project, take delivery of subsystems, test and integrate the subsystems into the Mark III interferometer.

In the past year, we have received prototypes of several subsystems that will eventually be incorporated into the Mark III interferometer. These include a siderostat from USNO, a laser system for siderostat monitoring from MIT, a new cat's eye assembly for the new 10 meter delay line, electronics for controlling the delay line, and an image correlation processor from MIT for the new star tracker. Testing of these various subsystems have shown the following: The siderostat bearings are very precise ( $< .5$  micron runout) but have excessive static friction. The USNO is currently modifying the siderostat. The laser system has been found to be extremely difficult to align because of the placement of the optical components. We plan to modify the design before incorporating it into the field instrument. The cat's eye assembly has required several minor modifications after initial assembly to eliminate static friction. One serious remaining problem is that the front plate that holds the piezoelectric transducers has a resonance near a harmonic of the 500 Hz drive frequency. This may require a major redesign to be performed in a subsequent contract.

In addition to progress in the construction of the Mark III, we performed a final series of tests with the Mark II interferometer at Mt. Wilson in the fall of 1984. The goal was to develop the software for

star switching with the interferometer. The instrument was programmed to observe fringes from four stars in a cyclic order A-B-C-D-A-B-C, etc. The siderostats had to be pointed at the star, the delay line then positioned to a few wavelengths of light to observe the fringe pattern. The technique of star switching is essential to ultrahigh accuracy astrometry and the software developed for the Mark II will be used on the Mark III which will use the same control computer. The process of finding the fringes on the Mark II took <2 minutes per star. Manual operation to find the central fringe of other stellar interferometers has often been a repeated exercise in frustration.

Last of all, the task of coordinating the technical efforts of the four institutions requires that we try to identify bottlenecks and potential bottlenecks that may drastically and unfavorably affect the successful outcome of the project. By far the most serious problem is the slow response time of the Navy contracting office. The bulk of FY85 funds is now more than 7.5 months late. If it were not for this delay, the project would be ahead of schedule. However, this 7.5 month delay, after we were told to speed up the program, in a program that started 19 months ago has and will continue to adversely affect our schedule and ultimately the probability that the project will be successful in the allotted time (four years) and budget.

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